A Sting in the Tale

An Experimental Investigation of Bronze Age Nettle Textiles in Northern Europe

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Abstract

The study of nettle textiles has been neglected in archaeology in favour of domestic crops such as flax or wool. This dissertation sought to determine what is involved in the production of nettle textiles and how they preserve in an experimental setting. Additionally, it investigated how to identify nettle textiles in the archaeological record, and their future in archaeology as well as in other industries. A nettle textile sample was created using Bronze Age technology where possible and guided by experimental archaeology research. Preservation of the textiles was investigated through burning in a furnace at a temperature range of 250-400°C in oxidising, reducing and under ash conditions.

The production of nettle textiles was time consuming and required large quantities of raw materials. Stings disappear upon drying, so the stems were not unpleasant to handle, but the activities were monotonous. Preservation through burning was unexpectedly good, carbonising at from 250-350°C under oxidising conditions. Remarkably preservation was poor in reducing and under ash conditions.

Despite poor preservation on archaeological sites, nettle textiles could be identified in environmental remains, silica on tools and even in dental calculus. Nettle fibres could be used in the future as a sustainable alternative to cotton, but processing issues would need to be solved. Nettle textiles are time intensive to produce so would have been seen as valuable objects in the Bronze Age. However, their production was not skilled so would likely have involved multiple people rather than one specialist.

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Glossary

Bast fibres: fibrous material from a plant stem collected in between the bark and core e.g. nettle, flax, lime, willow.

Cloth beam: roller at the top of a loom on which the cloth is rolled as it is woven.

Fibre yield: proportion of usable fibre from plant compared to waste products.

Hackling: combing fibres through a board set with vertical spikes to remove woody particles.

Heddle rod: movable beam that separates and raises the warp threads to allow the weft threads to be woven.

Plying: twisting two or more single threads into one to create stability.

Retting: also known as rotting, allows bacteria, moisture and enzymes to break down pectins in stems and allow fibres to be loosened from the core and bark.
Scutching: stems are hit with a heavy wooden blade over a table edge to release the bark.

Spindle whorl: small weight that helps to maintain speed of spinning.

Spinning: multiple fibres twisted into one long thread, often using a tool e.g. drop spindle, spinning wheel.

Splicing: strips of unretted fibre are joined together through twisting, after being stripped directly from the plant stem.

S/Z-spun or twist: refers to direction of spin in yarns, S means anti-clockwise whilst Z means clockwise.

Tabby: also known as plain weave, where warp and weft form a simple crisscross pattern. Most basic weave.

Warp: vertical threads on a loom that pass over and under weft threads to make cloth.

Warp beam: roller at the back of a loom on which the warp ends are wound.

Weaving shuttle: tool to compactly hold weft threads whilst weaving.

Weft: horizontal threads on a loom that pass over and under warp threads to make cloth.
1. Introduction

1.1 Background

Textiles, especially those made from wild plant fibres, are often neglected in archaeology, due to their poor preservation in the archaeological record. Fibres from the common stinging nettle (*Urtica dioica*) are frequently misidentified as flax, leading to a bias against them (Barber 1993). In reality, nettle fibres are soft (Bender Jørgensen and Rast-Eicher 2018:34), easily accessible (Kriiska et al. 2005: 23) and have a high tensile strength (Fischer et al. 2012). The ability of nettles to be transformed from something unpleasant to a soft fabric gave rise to the European fairytale motif that nettle shirts were magical (Hald 1942:34; Barber 1991:19). They are integral to the fairytale ‘The Wild Swans’ by Hans Christian Andersen, where a princess’s eleven brothers are turned into swans by an evil stepmother (Andersen 1838). To return them to human form, she must create nettle shirts for each of them, not speaking until her task is complete (Figure 1).

The recent excavations at Must Farm, Cambridgeshire have uncovered incredibly well-preserved textiles, including some made of fen nettles (non-stinging) (Keys 2016). The site was destroyed by a fire
in 1000-800 BCE, then collapsed into the River Nene where silt and anaerobic conditions preserved the organic remains (University of Glasgow 2016). This has prompted a great deal of recent interest in Bronze Age textiles.

This investigation will examine the significance of nettle textiles and their preservation in the European Bronze Age using experimental archaeology to recreate several samples. This approach will be complemented by reference to existing Bronze Age nettle textile examples in the archaeological record. The research will also seek to determine how labour intensive the production would have been as well as at what temperature of burning they can be preserved, rather than destroyed.

1.2 Structure of dissertation

Chapter 2 will review current literature on Bronze Age textiles, the nettle plant, nettle textiles and textile preservation. Chapter 3 will describe the methods chosen to investigate the research questions, as well as some observations on the effectiveness of the techniques. Chapter 4 will present the results of the burning experiment and a summary of general observations. Chapter 5 will explore the implications of the results in the context of the research questions as well as suggest avenues for future investigation.

1.3 Research Questions

1) What is involved in the production of nettle textiles?
   
   Very little research has been completed regarding nettle textiles, and none specifically for the north European Bronze Age.

2) How do nettle textiles preserve in an experimental setting?
   
   Nettle textiles are rarely found in the archaeological record, therefore their preservation through
burning and carbonisation will be investigated. This should help to determine how well they preserve, and perhaps why they are so rarely found.

3) Is it possible to identify nettle textiles in the archaeological record?

As nettle textiles are rare, this study will investigate possible proxies to identify their presence.

4) What is the future for nettle textiles in archaeology and beyond?

This study will likely raise further research questions and investigate the potential for nettles to be used commercially as an alternative fibre.
2. Literature review

In this literature review a brief overview of the Bronze Age will be explored, as well as relevant textile technologies. In addition, the varied uses of the nettle plant will be examined, and evidence of nettle textiles in several historical periods. Finally, textile preservation and experimental archaeology will be reviewed.

2.1 Bronze Age

2.1.1 Bronze Age Europe

Bronze Age England 2500-500 BCE (Bender Jørgensen et al. 2018:13) was filled with small, mixed farmsteads, with contact between dispersed families to keep the genetics of humans and animals healthy (DeRoche 2012:445). Settlements became more varied in size and layout during the 1st millennium and contact with the continent also occurred (DeRoche 2012:445). New production technologies developed, as well as the intensification of agricultural production and the fabrication of implements, ornaments and weapons (DeRoche 2012). In the Late Bronze Age (900-500 BCE), the importance of the individual increased, and a new secular aristocracy gained power (Heckett 2012:428). Bronze Age crops included oats, barley, rye, wheat and flax with domesticated animals such as cattle, pigs, sheep, goats and horses (Heckett 2012).

2.1.2 Bronze Age textiles

Textiles are rarely included in studies of the Bronze Age, but they played a socially and economically important role (Bender Jørgensen and Rast-Eicher 2016:68). Textile investigations can give information about selective breeding, processing of fibres and use wear (Andersson Strand et al. 2010:154), as well as social and political aspects of the past (Bender Jørgensen and Rast-Eicher 2016:68). Due to the time
and labour necessary to produce them, textiles would have been very valuable (Randsborg 2011:11). They were also often produced by women, so to overlook them is to also ignore the importance of Bronze Age women (Randsborg 2011:11).

Textiles are often neglected in archaeology, but they express identity and are one of the earliest human craft technologies (Andersson Strand et al. 2010:150). Although they tend to be rare, they are more abundant than generally assumed (Andersson Strand et al. 2010:151-2) and always deserve investigation when they survive.

2.1.3 Surviving Bronze Age textiles

In Britain, few examples of textiles survive from the Bronze Age and are usually from hoards and burials rather than domestic contexts (DeRoche 2012:444). The pieces from earlier literature have also been lost due to preservation difficulties, making it challenging to make reliable deductions (Bender Jørgensen 1992:18-19). However, the recent excavation of Must Farm has changed this lack of evidence. Must Farm is the largest Late Bronze Age collection of textiles in Britain, with super fine thread: some the diameter of a human hair (Must Farm 2016). Its exceptional preservation is due to a fire that carbonised the fibres, which were then buried in waterlogged conditions, where the sediments provided support for the artefacts (Figure 2) (Must Farm 2016). However, it should be noted that the post excavation results are yet to be published.
In Denmark, unique preservation conditions have produced multiple textile fragments, although few male garments have been found (Randsborg 2011:9). The most famous examples are from the Early Bronze Age oak coffins, where whole garments were preserved, for instance the Egtved girl (Randsborg 2011:13).

Textiles were costly in Bronze Age civilisations and later, so were likely also valuable in northern Europe, which are often overlooked by archaeologists due to preservation (Randsborg 2011:11). Smaller pieces of material were used to finish larger items (Randsborg 2011:28) showing that garments were valuable and worth repairing.
2.2 Textile technologies

2.2.1 Spinning

Until recently, spinning was thought to be the dominant method of thread production in prehistory (Gleba and Harris 2018). Spinning involves twisting several single pliable filaments into one long strong thread (Barber 1991:9). This is difficult, involving a wooden rod and a spindle whorl, of which only the spindle whorl survives in the archaeological record (Wild 1988:25). Retted and well processed fibres are drawn out from a mass of fibres on a distaff and twisted continuously using a rotating spindle which is left to hang in the air (Gleba and Harris 2018) (Figure 3). The spinner keeps pulling out fibres to create more yarn until the spindle reaches the floor, at which point the yarn is wound onto the spindle and the process is repeated (Wild 1988:29). The direction of the spin can be visible in the yarn and is recorded as Z or S-spun (clockwise or anti-clockwise) (Wild 1988:29).

Spinning only became the dominant technique in Europe during the urbanisation period of population growth across the Mediterranean, during the first half of the 1st millennium BCE (Krakowka 2018). Spindle whorls discovered at sites are not necessarily evidence of spinning as they could have been used to impart twist or to ply the yarns together (Krakowka 2018).
2.2.2 Splicing

Splicing is when strips of fibre are joined individually either by adding them continuously or by joined end to end through twisting (Krakowka 2018) (Figure 4). It does not require retting, so the fibres are stripped directly from the plant stalk (University of Cambridge 2018). It has always been assumed that retting and spinning were the dominant technology in prehistoric Europe, however splicing appears to have been very common (Krakowka 2018). Gleba and Harris (2018) analysed textiles from over 30 sites using a scanning electron microscope and determined that all the samples were produced through splicing. Bast fibre splicing was still practiced by indigenous communities in Korea, China, Japan and the Phillipines after spinning technology had spread to these areas (Gleba and Harris 2018; Nagano and
Hiroi 1999; Hamilton and Milgram 2007) suggesting that draft spinning is not necessarily a superior technology.

It is difficult to identify splicing in archaeological material, although Gleba and Harris’ (2018) study has begun to change this. Plying is usually necessary with spliced yarns, as they are inherently unstable and weaker at the splice point (Gleba and Harris 2018). Plying usually occurs in the anti-clockwise or S-direction (Gleba and Harris 2018) because nettle’s natural fibrillar orientation is S-twist (Bergfjord and Holst 2010). Threads vary in diameter considerably, perhaps due to differences in fibre strip widths within the same plant (base compared to tip) (Gleba and Harris 2018). The threads are also twisted minimally and retted less thoroughly to retain adhesive substances (Gleba and Harris 2018).

![Figure 4: Splicing process (a) Continuous splicing (b) end-to-end splicing (Gleba and Harris 2018)](image)

Experiments to recreate spliced Neolithic flax yarn by Leuzinger and Rast-Eicher (2011) found that the stems had to be retted for 10-12 days, then the fibre was stripped, wet fibres were divided into finer
strips, then joined by rolling the fibre ends between fingers, rolled around a spool and left to dry, then plied.

All the European Bronze Age textiles analysed by Gleba and Harris (2018) have been identified as made with plied spliced yarn, suggesting that spinning was not used in Bronze Age Europe. Splicing appears to be the earliest technique of thread production developed with plant bast fibres (Gleba and Harris 2018) which makes sense as it requires no tools. Splicing is assumed to be slower than spinning (Tiedemann and Jakes 2006) so perhaps draft spinning was developed due to a pressure to produce more yarn (Gleba and Harris 2018).

2.2.3 Egyptian splicing

Splicing technology has been acknowledged much earlier when studying Egyptian material. It was used from the Middle Kingdom onwards as can be seen in tomb decorations at Dagi (Figure 5); Khety and Djehutyhetep (Kemp and Vogelsang-Eastwood 2001:69; Wild and Wild 2014). Bundles of flax fibres would have been processed, perhaps by passing them between two wooden sticks to remove the bark (Kemp and Vogelsang-Eastwood 2001:70). These cleaned bundles would then be rolled along the right thigh, whilst drawing out fibres into a fine thread (Kemp and Vogelsang-Eastwood 2001:70; Baines 1989:19). The figures are also depicted drawing the thread through their mouth, which would loosen the pectins and make the fibres smoother, however flax is full of impurities so would have been very unhealthy (Kemp and Vogelsang-Eastwood 2001:71; Baines 1989:26). Saliva supposedly contains enzymes that would convert cellulose into a glue to hold the fibres in place (Kemp and Vogelsang-Eastwood 2001:71; Barber 1991:72).
Figure 5: Detail of a wall-painting in the tomb-chapel of Dagi at Thebes (TT103), showing the preliminary preparation of flax: the second woman from the left is probably splicing the flax together (Vogelsang-Eastwood 2000)

In experimental research (Cooke et al. 1991), the participants struggled to get the rigid ribbons to stick together even when wetted or licked, although soaking the flax for 24 hours helped. They also found that natural pectins and gums aided the joining process (Cooke et al. 1991:22; Kemp and Vogelsang-Eastwood 2001:73). They rolled fibres between their hands to begin the twist, then rolled them on the right thigh which created a tight twist (Kemp and Vogelsang-Eastwood 2001:73; Cooke et al. 1991). If anchored to a piece of wood, the thread could be pulled by a helper and wound up, as the splicer continued working (Kemp and Vogelsang-Eastwood 2001:73; Cooke et al. 1991). They concluded that ancient workers would have spliced vigorously and efficiently (Kemp and Vogelsang-Eastwood 2001:73; Cooke et al. 1991).

2.2.4 Weaving

Bronze Age weavers used a range of different fibres, for instance flax, wool, goat hair and nettles, but rarely mixed them within one woven piece (Bender Jørgensen and Rast-Eicher 2018). Choice of weave type would depend on technical ability and skill of the weaver, as well as available weaving devices (Grömer 2013:60). The most popular weave in the Bronze Age was plain or tabby, which is the simplest
type (Wild 1988:41; Grömer 2013:60) (Figure 6). The warp thread has to withstand more pressure during weaving so is often more tightly spun than the weft (Wild 1988). Looms have not survived in the archaeological context, making it difficult to know what types would have been used in various periods (Wild 1988). Upright warp weighted looms are known before 2000 BCE in southern and eastern Europe (Barber 1991:252) meaning that they were likely used in northern Europe. In Denmark the textiles were up to 2m wide and 4m long, so the looms must have been able to accommodate those dimensions (Randsborg 2011). There also seem to be no regional differences in cloth quality by numbers of warp threads per centimetre in Denmark (Randsborg 2011:29) perhaps suggesting a similar weaving tradition across the country.

![Figure 6: Plain or tabby weave (Textile Resource Center n.d.)](image)

Other methods of fabric production include tablet weaving which can be found at Hallstatt, Austria, and can create interesting colour patterns and motifs (Grömer 2013:87). Tablet weaving produces long
narrow pieces of cloth that can be stitched together for larger garments (Randsborg 2011:21). Non-woven fabrics would also have existed in the Bronze Age, for instance basketry, netting and matting, which are usually the earliest forms of textile production (Wild 1988:50).

2.3. Nettle plant

2.3.1 Nettle description

The common stinging nettle (*Urtica dioica*) grows in Europe, North America, North Africa and parts of Asia (Kew Science n.d.). It grows in moderate and cold climates (Kicińska-Jakubowska et al. 2012). Nettles are an abundant herbaceous perennial plant, growing rapidly from springtime and reaching up to 2m high (Camira n.d. a; Harwood and Edom 2012). They have soft serrated leaves in pairs opposite each other on the stem, with yellow roots and tiny green-white flowers (Kew Science n.d.) (Figure 7). There are at least five subspecies which are each slightly different (Kew Science n.d.). They prefer to grow in nutrient rich soils, especially those with high concentrations of phosphates and nitrates, allowing them to be used as an indicator of human habitation (Smith 2013).

The name ‘*uro*’ derives from Latin and means ‘I burn’, referencing its unpleasant sting (The Poison Garden n.d.; Harwood and Edom 2012), with ‘*dioica*’ referring to male and female flowers appearing on separate plants (Harwood and Edom 2012). Formic acid is responsible for the initial pain from the sting, with the longer effects caused by histamines, acetylcholine and 5-hydroxytryptamine (The Poison Garden n.d.). The stings occur when these toxins are delivered into the skin using specialised hairs. The bulbous tip of the hair breaks off and leaves a needle-like tube that pierces the skin (Kew Science n.d.). The itching and burning can last up to 12 hours (Kew Science n.d.).
Individual fibre cells may be 5cm long, with the surface usually marked and distorted in many places (Gordon Cook 1984:25). The cells are oval with thick walls and rounded ends and a narrow lumen containing yellow material (Gordon Cook 1984:25). This could be used to identify nettles in the archaeological record, as they are sometimes mistaken for flax.
Nettles grow easily on floodplains, brownfield sites and over fertilised fields, creating a diverse ecosystem as they provide a natural habitat for rabbits, birds, frogs, toads (Camira n.d. a) and over 40 species of insects (Kew Science n.d.). They can also be grown on marginal land and sites that are not suitable for food production, making them cost effective (Yorkshire Post 2009).

2.3.2 Food

Young nettle shoots in spring can be harvested for food (Jabs 2013), using them in soups, salads and teas. Historically, nettles have been used to make puddings, beer, the rind of cheese, and pesto (Kew Science n.d.). Nettles can also yield a vegetable protein similar to tofu (Kew Science n.d.), as it has a protein content of 33.8% (Adhirkari et al. 2016). Per 100g, nettle powder has 169mg of calcium and 277mg iron as well as vitamin A and C (Adhikari et al. 2016), making it nutrient dense. Cooking nettles destroys the stings (Kew Science n.d.).

2.3.3 Dyes

Nettles can be used to produce natural dyes in yellow and green (Cambridge University Botanic Garden n.d.), using the roots and leaves respectively. In addition, it can be used in chlorophyll production (Vogl and Hartl 2003; Bredemann 1959) and may have been used to dye camouflage netting green ahead of the D-day landings in World War Two (Harwood and Edom 2012).

2.3.4 Medicine

Medicinally, a tonic made from nettle leaves is a very popular plant remedy, with nettle soup having a reputation for ‘cleansing the blood’ (Kew Science n.d.). ‘Urtication’ involves using nettles to stimulate circulation and bringing warmth to joints and extremities (Adhikari et al. 2016; Green 1820). Recent research has shown that the stings have anti-inflammatory properties that that could be used to treat
rheumatism (Upton and D’Ayu 2013). They have also been used to treat anaemia (due to their high iron content), gout, eczema and hypoglycaemia (Suryawan et al. 2017).

2.3.5 Mythology

Nettles are said to have been introduced to Britain by Roman soldiers who would beat themselves with the leaves to keep warm, but given that the plants die back in winter, they would not have been available, therefore the story is likely untrue (The Poison Garden n.d.). There is also a belief in the Highlands and Islands of Scotland that nettles grow from the bodies of the dead (The Poison Garden n.d.), perhaps due to the high nitrogen content of the bodies. Similarly, if many nettles grow together, it is a sign that innocent blood has been shed there and can never be eradicated (Hald 1942), again likely due to the nutrient content of any buried bodies. A colony of nettles is also supposed to be an entrance to a dwelling of the elves (Hald 1942:45).

Nettles are involved in multiple myths surrounding protection, including as one of the nine kinds of greens in the Maundy Thursday’s cabbage, which then protects against sorcery for the rest of the year (Hald 1942:43). In addition, nettles are said to prevent milk from being bewitched by house trolls and witches, prevent cabbage from being eaten by larvae and guard humans from vermin (Hald 1942:45).

They are also involved in love spells: if you beat yourself with a nettle you can count from the blisters how many years before you get married (Hald 1942). If a girl plants a nettle in wet sand and it bends overnight you can tell what quarter her suitor will come from, but if the tip bends downwards the girl will soon die (Hald 1942:45). In Germany, the nettle is a symbol of miserable and hopeless love trouble (Hald 1942:45). All these myths demonstrate the human interest in nettles as a magical protective plant, likely due to its stinging ability.
2.4. Nettle textiles

2.4.1 Properties of nettle textiles

Nettle fibres are soft and pleasant to handle, from creamy white to grey in colour depending on retting, with strands up to 60cm in length (Bender Jørgensen and Rast-Eicher 2018:34). Stinging nettle is a bast fibre plant, meaning that the fibres are collected from the phloem or inner bark surrounding the stem, which involves a complex and time-consuming chaîne opératoire (Gleba and Harris 2018). Generally, the use of nettle fibre is less well documented than other fibres, for instance flax or wool (Walton 1989). As a fibre source, nettles are easily obtainable and grow en masse, so are unlikely to have remained unexploited in prehistory (Kriiska et al. 2005:23). Nettle fibres are made of cellulose (Harwood and Edom 2012) which are absorbent, flammable and resistant to alkalis, but usually preserve poorly (Cameron et al. 2016:151; Harris 2010:106).

Nettle fibres have a high tensile strength (Fischer et al. 2012; Bodros and Baley 2008) and are hollow, which provides natural insulation in winter clothes (Preuss 2017). When the yarn lengths are closed it reduces their insulation, so they can be worn in summer (Presuss 2017). In addition, they have fire retardancy properties especially when combined with wool (Harwood and Edom 2012; Lepisto 2009; Camira n.d. a) which could be useful for at risk fabrics, such as nightwear (Kids Health 2016).

Wild nettles have a lower yield than other commercial textile crops, but high yield cultivars have potential (Harwood and Edom 2012). Fibre nettles were bred by Bredemann in his 1959 experiments, creating frost tolerant, long stems with a high fibre content (1.2-16%) (Vogl and Hartl 2003:119-120).
Ramie (*Boehmeria nivea* or *Boehmeria tenacissima*) is a species of stingless nettles, which can produce fabric (Gordon Cook 1984:22) and are currently used in Nepal but will not be covered in this study as they were not available in the European Bronze Age. The small nettle (*Urtica urens*) and the Roman nettle (*Urtica pilulifera*) can also be used for fibre but have a lower yield than *U. dioica* (Gordon Cook 1984:25) so will not be covered.

### 2.4.2 Processing and Extraction of nettle fibre

Extraction of the fibre has always caused difficulties and was traditionally carried out manually (Harwood and Edom 2012). Nettle fibres are found in between the bark and woody core (Gordon Cook 1984:25) and held with pectins, meaning that either retting or mechanical processing is needed to release them. Dew and water retting can be used for both nettles and flax but are unreliable and inconsistent (Harwood and Edom 2012). Other possible methods include applying a desiccant to the crop at its flowering midpoint; steam explosion of stems; and the application of enzyme formulations (Easson and Long 1992; Sharma et al. 1989; Kessler et al. 1998; Akin et al. 2002).

Nettles can be processed in a similar way to flax: retting, breaking, ‘scutching’ and ‘hackling’ (Wild 1988:22). Retting involves submerging the stems in water for 3 weeks to allow the bacteria to loosen the fibres from the core and bark (Wild 1988:22). The stems are then dried thoroughly and beaten with a wooden mallet of a flat surface to break them (Wild 1988:22). Then the stems are struck with a heavy wooden blade over a narrow edge to release the bark (‘scutching’). Hackling involves combing the fibres through a hackle, a board set with several rows of vertical iron spikes, to dispose of remaining woody particles (Wild 1988:22). They can also be stripped directly from the unretted stem as in this study, using either the Hurcombe (2010) or Mears (2005) method, which is explained in sections 3.5 and 3.6.
2.4.3 North European Bronze Age nettle textiles evidence

Nettles likely began to be used in the Mesolithic, although tangible remains are not found until the Neolithic and Bronze Age in Denmark (Kriiska et al. 2005:23). Very few nettle textiles from the Bronze Age have survived in the archaeological record. The examples in Table 1 are all plain weave, however their site types, dates, thread types and preservation all vary. Given the small sample size, any conclusions or summaries should be very cautious.

Table 4: Surviving Northern European Bronze Age nettle textile examples

<table>
<thead>
<tr>
<th>Site</th>
<th>Must Farm, Cambridgeshire</th>
<th>Pyotdykes, Scotland</th>
<th>Lusehøj, Denmark</th>
<th>Whitehose Hill, Dartmoor</th>
<th>Overbarrow, Cambridgeshire</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date</td>
<td>Late Bronze Age, 930-790 cal BCE</td>
<td>Late Bronze Age, 8th century cal BCE</td>
<td>940-750 cal BCE</td>
<td>Bronze Age</td>
<td>Early Bronze Age, 1887-1696 cal BCE</td>
</tr>
<tr>
<td>Site type</td>
<td>Settlement</td>
<td>In spearhead socket</td>
<td>Cremation burial</td>
<td>Burial</td>
<td>Cremation burial beneath a barrow</td>
</tr>
<tr>
<td>Single example or group</td>
<td>Group</td>
<td>Single</td>
<td>Single</td>
<td>Single</td>
<td>Group</td>
</tr>
<tr>
<td>Fibre type</td>
<td>Flax and nettles (fen)</td>
<td>Nettle or flax</td>
<td>Nettle</td>
<td>Nettle</td>
<td>Nettle or flax</td>
</tr>
<tr>
<td><strong>Spin/splice</strong></td>
<td>Splicing</td>
<td>S spun, 2 ply</td>
<td>S spun</td>
<td>Z spun, S plied, 2 ply</td>
<td>Splicing, z twist, S plied, 2 ply</td>
</tr>
<tr>
<td>-----------------</td>
<td>----------</td>
<td>----------------</td>
<td>--------</td>
<td>------------------------</td>
<td>----------------------------------</td>
</tr>
<tr>
<td><strong>Thread diameter/mm</strong></td>
<td>0.16-0.32</td>
<td>Not available</td>
<td>0.3-0.5</td>
<td>0.5-0.8</td>
<td>0.5-0.8</td>
</tr>
<tr>
<td><strong>Weave</strong></td>
<td>Plain</td>
<td>Plain</td>
<td>Plain</td>
<td>Plain</td>
<td>Plain</td>
</tr>
<tr>
<td><strong>Threads/cm</strong></td>
<td>22-23</td>
<td>28x24 threads per inch</td>
<td>Not available</td>
<td>Not available</td>
<td>12-15</td>
</tr>
<tr>
<td><strong>Preservation</strong></td>
<td>Charring, silt replacement</td>
<td>Possibly lack of oxygen</td>
<td>Possibly lack of oxygen in barrow</td>
<td>Peat bog</td>
<td>Charring</td>
</tr>
</tbody>
</table>
Several of the examples in Table 1 are not confirmed as nettle, for instance the Pyotdykes textile has been identified as linen (Figure 8a) (Henshall 1964) and nettle (Hedges 1974). The Whitehose textile was confirmed as nettle, however the sample was small and may not be representative of the whole object (Cameron et al. 2016:151) (Figure 8d). The Over Barrow textile is definitely cellulose but could be nettle or flax (Figure 8b) (Harris 2012). Given the similar appearance of flax and nettles, it would be worth re-analysing existing samples to check for misidentification. Plant fibre textiles in general are also likely more common than previously assumed (Mannering, Gleba and Bloch Hansen 2012:97), as at Must Farm, all the textiles are made from plant fibres (University of Cambridge 2016). Excavations at Must

Figure 8: Surviving Bronze Age nettle textiles (a) Pyotdykes (Henshall 1964) (b) Lusehoj (Bergfjord et al. 2012) (c) Over Barrow (Gleba and Harris 2018) (d) Whitehose (Cameron et al. 2016)
Farm have revealed many textile examples, however the post excavation results have not yet been published, so there are no specific details on the nettle textile found.

A key nettle Bronze Age example is the fine fabric wrapped around cremated remains and placed in a bronze urn at Lusehøj barrow, Denmark (Figure 8b) (Bender Jørgensen and Rast-Eicher 2018:34). The burial mound was likely for a wealthy and powerful person (Graven 2012; Bergfjord et al. 2012). Initially the textile was assumed to be made of linen, but recent measurements of the fibrillar orientation of the fibres and verifying the presence of calcium oxalate crystals has shown that it is actually made of nettles (Bergfjord et al. 2012). This has challenged the assumption that the majority of textiles were made of domestic crops such as flax, rather than ‘wild’ plants. Furthermore, isotope analyses have shown that it was not created in Denmark and could have been imported from Austria (Bergfjord et al. 2012). This suggests that the fabric was a luxury item, perhaps traded along similar routes to bronze artefacts (Bergfjord et al. 2012). Given that flax was readily available, it also suggests that nettles were a deliberate choice, perhaps linked to the deceased person (Bergfjord et al. 2012), superior thermal qualities or a ritual significance (Graven 2012).

2.4.4 Historical evidence

Nettle fibre was still used in Great Britain until 1860 as a strong durable cloth, until cheaper imported cotton caused its decline (Harwood and Edom 2012). Elizabeth I slept in a ‘nettle bed’ and Napoleon’s army was thought be given ‘local’ nettle uniforms (Bennett 2004; Harwood and Edom 2012). In Scotland, nettles were frequently used to make tablecloths and sheets, where ‘nettlecloth’ became a catch-all term for any fine material (Bennett 2004) showing that the fabric must have been high quality.
During both World Wars, Britain and Germany investigated nettles due to a shortage of cotton, with varying levels of success (Harwood and Edom 2012). In World War One, Germany supposedly collected 10,000 tonnes of wild nettles, yielding 1,500 tonnes of fibre as well as 3,000 tonnes of food products (Harwood and Edom 2012). A breeding program was then initiated to improve yield, which increased maximum fibre content to 17% (Bredemann 1959; Harwood and Edom 2012). Oswald Richter, an Austrian researcher, claimed that he had solved the extraction problem, and that Austria would become independent of foreign cotton (Harwood and Edom 2012; Schiller 1916). However, with all of these examples there is a strong incentive for a wartime propaganda narrative of self-sufficiency, so the claims could be exaggerated.

In World War Two, Britain needed cellulose to create paper and rayon and could theoretically have used nettles (Harwood and Edom 2012), but there is little evidence that nettle fibre was ever used on a commercial scale (Oakley 1942). Various experiments were carried out to see if nettles could be used for textiles, however the extraction of fibre from the stems remained a serious issue (Harwood and Edom 2012). Nettle rayon produced was suitable for parachutes, but there was insufficient supply, so the trials remained in the lab (Harwood and Edom 2012). It seems that an interest in nettle fibres has historically coincided with periods of political and economic upheaval, when access to cotton is restricted (Harwood and Edom 2012).

Use of nettles continued into the 20th century in Scandinavia (Hald 1980:126) and in northern Siberia (Kriiska et al. 2005:23). Certain species of stinging nettle are still grown in France and Germany for their fibre (Gordon Cook 1984:25), especially the high fibre cultivars created by Bredemann (1959).
2.4.5 Linguistic evidence

Several languages contain evidence of nettles as a fibre plant, for instance the original meaning of the Finnish *pellava* (flax) was nettle (Toikonen et al. 1962:514; Kriiska et al. 2005:24) suggesting that flax replaced nettle as the dominant fibre. Similarly, in Latvian there is an analogous relation between nettle (*nātre*) and linen (*nātns*) (Mülenbach 1925:702; Kriiska et al. 2005:24). This suggests that nettles were perhaps used before flax or treated in a similar manner.

In English, nettle comes from the Old English *netele*, perhaps from the Proto-Indo-European root *ned-,* meaning to bind or tie (Etymonline n.d.). Therefore, there is a possible link to nettles being used for cordage in early prehistory, or perhaps even a link to net-making (Hald 1942:39). Non-woven fabrics (basketry, netting, matting) were prehistoric humans earliest textile production (Wild 1988) so it would be interesting to investigate how early nettles were used in this context (Edom 2010).

2.4.6 Environmental considerations

In recent years, nettles have been investigated as a renewable and sustainable resource, especially compared to the damage caused by growing cotton (Harwood and Edom 2012) which uses 20% of the world’s pesticides (Bennett 2004). The amount of fibre is generally low, around 4-7%, compared to flax’s 20-30% (DEFRA 2004) meaning that it may not be economically viable to produce. They also have a high variability in length and uniformity of fibres (Harwood and Edom 2012), making standardized production difficult. However, as demand for textiles increases pressure on the environment, nettle fibres may be considered more sustainable in the future (Harwood and Edom 2012).
2.5 Preservation

Ancient textiles rarely survive in the archaeological record as they are organic. Preservation is usually due to extreme dryness, cold or anoxic conditions or after carbonisation (Peacock 2001:184). Fibres can also be partially or entirely preserved by replacement with mineral salts (Wild 1988:7) or leave impressions on surfaces of other objects (Peacock 2001:184). Contact with metal objects can inhibit decay or form replicas as the metallic oxides replace the organic fibres (De Roche 2012:446; Hedges 1973), for instance ferric oxide or copper alloy oxides (Crowfoot 1951:167). Copper alloys have biocidal properties that can destroy bacteria that would have damaged the textiles, allowing them to survive (Peacock 2001:184). Mineral replacement can create casts of the textiles (Peacock 2001:184), which are larger than the original (Jakes and Howard 1986; Peacock 2001:185) but can still provide evidence when the organic material has decayed.

Carbonised fibres in the archaeological record tend to be of plant origin, as cellulose preserves poorly in wet environments (Peacock 2001:185). Carbonisation sometimes alters the morphology of the fibre, making identification impossible (Peacock 2001:185).

At Must Farm, the fire that ended its occupation also carbonised the organic textiles and fibres, which were then buried in waterlogged conditions, where sediments provided support for the artefacts (Must Farm 2016). These exceptional conditions have allowed access to materials that would normally decay and perhaps show what a ‘normal’ site might look like.

2.6 Experimental archaeology

Experimental archaeology allows the reproduction of former conditions to experience ancient life, by setting and answering a relevant question (Coles 1979:1, 43). Experiments cannot be reconstructions, as
tested aspects are always hypothetical, but they should still be as rigorous as possible (Outram 2008:2-3).

Coles’ (1979:46) rules have been followed wherever possible: materials and methods would have been available to Bronze Age society; the scale of work has been assessed and fairly stated; results have not been taken as proof; honest errors have been stated and when necessary improvisation has been explored. However analytical studies and repetition have not been carried out due to time constraints.

Reynolds (1999:158-62) defines five types of experimental archaeology: constructs; process and function experiments; simulations; eventuality trials and technological innovations. This investigation will be a simulation exercise to better understand the production of nettle textiles (Coles 1979:36). The study will also be ‘actualistic’, as it attempts to determine how textile production would have actually worked for past people (Outram 2008:2).

There are several limitations to experimental archaeology, for instance experiments are often small scale to reduce cost (Coles 1979:41), in this case only making a small textile sample instead of a full garment. Other limitations include that experimental archaeology is not the complete answer, as they may be no ‘complete answer’, but it can help to establish a series of facts (Coles 1979:246). Common issues include: a lack of clear aims, insufficiently detailed materials and methods; compromises over authentic material; inappropriate parameters and a lack of academic context (Outram 2008:4-5). Surviving remains may be representative or biased and misleading (Coles 1979:244) which guide experiments to also be biased. Experimental testing does not include all aspects of cultural behaviour, for instance social, political and religious ideas that we are unable to access (Coles 1979:241).
2.7 Conclusion

Current research has not investigated Bronze Age nettle textiles or spliced nettle textiles, so this study will seek to remedy this. The literature review has shown that identifying textiles in the archaeological record is difficult due to poor preservation. In addition, this research shows how important textiles would have been in the past, and that they deserve more thorough investigation. The future of nettle textiles is promising given their positive environmental impact, and their varied uses in food and medicine suggest increased investigation.
3. Methodology

3.1 Methods to answer research questions

Research question 1 will be answered by producing a sample of nettle textile using Bronze Age tools and techniques wherever possible in Chapter 3. Question 2 will be answered by burning the sample at varying temperatures in a furnace to investigate carbonisation in Chapter 4.2. Questions 3 and 4 will be answered in Chapter 5 using relevant research.

Each stage of the methodology can be seen in Figure 9.

Figure 9: Nettle textile simulation methodology flowchart
3.2 Harvesting

Stinging nettles (*Urtica dioica*) were cut from Durham’s Botanic Garden North American Arboretum using a sharp metal billhook borrowed from the Head Gardener. No experimentally made bronze or flint tool was available for use.

Batch A and B nettles were only 1m high in September 2018, likely due to the extreme hot weather in Summer 2018, and were also mixed with other plants, which made collection difficult because the nettles had to be selected individually. They were also growing sparsely which made harvesting time consuming (10 stems/minute). Batch C and D nettles were around 2m tall and cut in October 2018 (Figure 10a). Other plants had died back making it easier to isolate the nettles. Although the thicker stems were easier to cut without pulling out the root, it still happened occasionally.

Protective gloves, a long sleeved top and a hat were worn to repel stings, which was essential when cutting taller stems that would touch the back of the neck. Gloves were tucked in the top rather than over, as they tended to ride up and let the arm be stung. Even with this protection, stinging still occurred.

Harvesting with the billhook was initially challenging, as the tool must be angled towards the body and up to cut. Cutting a handful at a time close to the ground was much more efficient, as the already picked stems push surrounding uncut ones away and help prevent stings. Grasping several stems in the left hand and cutting firmly with the right helped to keep tension and make cutting smoother. Even with these techniques, roots were still pulled out accidentally, which would prevent the plant from growing back the following year, so was avoided wherever possible.
Cut stems (Figure 10b) were transported from the Arboretum to the retting area wrapped in a plastic sheet, (which is not Bronze Age authentic, but any sort of fabric would be effective) or carried in a bundle under the arm whilst wearing gloves, which prevented stinging. About 200 stems were carried in each bundle, which was heavy but manageable. Carrying the taller stems in a bundle kept them well balanced and together, which made dropping stems less likely.

3.3 Stripping leaves

Only the fibre inside the stem was needed, so the leaves were stripped off. This was difficult when the stems were fresh because the leaves are bushy and firmly attached but became much easier when they had dried out for a day. Wearing gloves and holding a bundle of 10 at a time, the stems were pinched using thumb and forefinger, then the finger pincer was pulled up the length of the stem to pull the leaves off. Whilst sitting down made this process more comfortable, any broken stems caused issues because they halted the smooth motion. The waste products were the nettle leaves, which can be composted or used as animal feed (Bauditz 1917).

The process had to be adapted slightly for the taller nettles as they were heavier and had offshoots. The stem tops were held in the left hand, whilst the offshoots were stripped top to bottom with the right hand, then the other leaves were stripped with the left hand (non-dominant) as it required less force. Stems without offshoots could be stripped in either direction (top to bottom or vice versa). It took 2 hours and was tiring as the stems were heavier and larger than my arm-span.

3.4 Retting

Nettle stems (Figure 10c) can be retted to free the bark from the woody core (Gordon Cook 1984:25) and allow fibre removal (Harwood and Edom 2012). Retting means rotting and allows the naturally
occurring bacteria and enzymes to break down pectins in the stems, allowing the fibres to be released (Harwood and Edom 2012). It also sometimes removes the bark entirely, decreasing the need for cleaning.

3.4.1 Dew retting

The process of dew retting allows moisture and fungi to break down the pectins, but is dependent on weather conditions and is unreliable, although turning the stems can help to ensure even retting (Harwood and Edom 2012). Ford (2014) suggests leaving stems outside for 6-8 weeks, turning daily until the outer bark has rotted, then rinsing the stems, drying and storing. Stripped stems were laid flat on weedy grass, wool sheets, and soil as no area of grassy lawn was available initially, leaving a 2cm gap between each stem. This was time consuming, especially on the irregular weedy grass, which prevented them from laying on the ground, but did not affect retting. The wool sheets resulted in damp stems, which suggests that a surface with good drainage is necessary for dew retting. However once placed on grass the retted stems all had a similar consistency.

Turning over all the stems took 20-30 minutes each time, although a ‘twiddle’ motion with thumb and forefinger on the centre of the stem proved the easiest method. It was also easy to forget which side had been facing up as the stems look very similar but made no noticeable difference to the retting process. Turning daily proved unnecessary, as twice weekly or weekly was sufficient, which saved time. Increasing space between the stems prevented tangling and helped faster turning.

The stems were vulnerable to high winds and were blown about so a sheltered area would have helped to contain them. Unfortunately, half of the stems were thrown away by the gardeners and so had started to decay (22nd-29th September 2018), so when recovered were separated and called Batch A
Figure 10: (a) nettles growing in the Botanic Gardens, Durham (b) cut nettle stems (c) cut nettle stems with leaves removed (d) interior of dew retted stem (Sawyer 2018)
(original) and B (had been in the skip), in case this had an effect on the fibre. The stems were also re-laid in a more sheltered area on grass.

By 4 weeks Batch A seemed to be fully retted, as it broke easily with no smell (Ford 2014) whereas Batch B was still varied, with some soft and some dry. It was very difficult to know what fully retted stems should look like. Both Batch A and B seemed to have a mixture of white bleached stems and dark mouldy ones (Figure 10d).

Batch A and B were placed on wooden shelves to help them dry out after 4 weeks but were not rinsed in cold water as suggested by Ford (2014). Fibre was not extracted from Batch A and B for 12 weeks, which may have had an effect on fibre quality.

3.4.2 Still cold water retting

Cold water retting involves immersing the stems in pools of water and leaving them until the bacteria have rotted the stems, although this pollutes the water and creates a bad odour (Harwood and Edom 2012). Bundles of stems are submerged in a large container of water at 15-25°C for 5-6 days (Ford 2014). However, this temperature would be very difficult to achieve in autumn so was not attempted. This process could be done indoors, but the water must be changed daily, and it produces a pungent odour.

3.4.3 Running cold water retting

Running cold water retting involves submerging bundles of about 50 stems in a stream (15°C or warmer) for 6-8 days (Ford 2014). This method is meant to result in less odour but possibly pollutes the water
downstream (Edom 2010). The stream in the Botanic Gardens was too shallow and muddy for this form of retting to take place, so was not attempted.

3.4.4 Hot water retting

Hot water retting involves boiling the bark to release the fibres (Gordon Cook 1984:25). This process should take 4-5 days at 25-35°C (Ford 2014). This was not carried out due to equipment constraints.

3.4.5 Root retting

Promoted by Ford (2014), root retting involves leaving the nettle stems in the ground over winter, then harvesting in spring. This allows the weather and frost to ret for you. However, this was not used due to time constraints.

3.4.7 Inadvertent retting

In December, around 200 tall stems were accidentally left in the rain and became very damp and soft. Whilst they were damp, I was unable to extract fibre, so they were placed under cover to dry out for around 6 weeks. This may have initiated the retting process and affected the fibre, although this does not seem to have occurred.

3.5 Extracting fibres

Initially extracting fibre from the stems was difficult, as I tried squishing the stem to crack the outer bark, then peeled to access the fibres, which was ineffective. I used Brown’s technique (2018), using my right thumbnail to split the whole stem vertically (Figure 11a), then snapped the stem horizontally in segments, and pushed out the dry woody core. I pushed the broken core segment up gently to the
release the fibres, then push it back towards me to release any extra fibres (Brown 2018). If the core remains intact, pushing it is much easier. The fibre tends to ‘catch’ on the nodes, so breaking the core above and below the node helps to keep the fibre undamaged. It is also more efficient to break long pieces of core above and below the node rather than short pieces. Retted and unretted fibres are extracted using this same method.

In the Neolithic bast fibres were extracted and cleaned with a flint micro-denticulate or serrated edge flake, which results in a silica rich deposit along the edge of the tool (Hurcombe 2010). The Hurcombe method was developed using the flint micro-denticulate tool to scrape down the nettle stem, removing the bark (Hurcombe 2010). Then the stem is split in half, dried and the fibres are gently stripped from the stem (Hurcombe 2010:136). This method required around 15 minutes active processing time per stem, so would require large time commitments on a seasonal basis each year (Hurcombe 2010). This method was attempted on dry stems using a metal butter knife with limited success, likely because stems were too stiff. No flint tool was available, and there is no available evidence of this process in the Bronze Age, so Brown’s (2018) method was used for all stems. It is also possible to extract fibres by baking (Ford 2014) but this was not carried out because extracting by hand did not require maintaining a constant low temperature in a fire or oven.

Roots are unusable for fibre extraction because they have a tougher outer skin and are usually curved. Tips, or the top 10-20% of the stem, are also unusable as they have very little fibre (Vogl and Hartl 2003:125). Tall and thick (around 1cm diameter) nettle stems are the best for producing fibre.

This is quite time consuming (around 3-5 minutes per stem) and results in fine green fibres which are still attached to the dark outer bark (Figure 11b). Unretted fibres are held together with pectins and are
damp to the touch, whilst the retted ones are pale grey and soft. The waste products are broken pieces of woody core which could be used as kindling. The process is also messy even with a cloth underneath.

Extracting should be done under shelter as the wind blows the lightweight fibres away. Thumbnails needed to be at least 5mm long to break the stem, which made them sore after repeated use, but did not break the nail. The most effective position was sitting in a chair, with a low table in front, and a cloth

Figure 11: (a) splitting stem to extract fibre (b) extracted fibres (c) process of cleaning fibres (d) cleaned Batch C fibres (Sawyer 2019)
on the knees and table to catch the waste products. Some form of distraction was also essential as the activity is monotonous. It was also much faster with two people, so perhaps would have been a communal activity.

It’s possible that the retted stems have less fibre than the unretted stems, either due to incorrect dew retting or their comparatively small size, although a direct comparison was not carried out. They were also dustier than unretted stems as the bark has decayed.

3.6 Clean fibres

Fibres have to be cleaned whether retted or not, as they retain bark and core fragments after extraction. Cleaning with fingernails is possible but time consuming and the fibres become tangled very quickly. Cordage can also be created without cleaning the fibres or removing the bark, to create a rough yarn (Mears 2005; Hurcombe 2010).

The method used in this study was inspired by Brown (2018), a nettle fibre expert. I was unable to source a serrated edge flint scraper, so used a blunt butter knife which has a very similar serrated shape. This tool proved very effective in catching fragments of bark and pectins without damaging the fibres. Several pieces are gripped in the left hand, the knife is held in the right hand, with the right thumb underneath the bundle, then the knife is dragged towards you, lightly scraping the fibres (Figure 11c). Changing directions ensures all the sections of the fibre are cleaned.

Given that recent research suggests prehistoric textiles were spliced and not retted or spun (Gleba and Harris 2018), some method of cleaning the bark from the fibres was necessary. Using the butter knife or
flint serrated edge flake may not be specific to the Bronze Age, but no other methods were available for experimentation.

Fibres become softer and paler as the impurities are removed (11d). The short pieces are lost from the fibre lengths as you scrape, but it’s possible that these can be used when carded, although this has not been successful in my attempts. Cleaning is time consuming, about 20 minutes per stem.

This should be done under shelter so that the fibres do not blow away. It is also messy, so a cloth underneath is necessary. The most comfortable position is the same as extracting fibres: sitting in a chair with a cloth on your knees. It is easy to accidentally cut the fibres, which are already fairly short so need to retain their length. Retted stems are easier to clean because they have less bark but feel drier and more fragile, so you have to be gentle so as to not break the fibres. They also produced fewer bark splinters, but more dust than unretted stems. This activity was also monotonous and required distraction, although average speed increased with practice.

Dry bark fragments and leftover stings on unretted stems have a tendency to spike fingers but drying the extracted fibres for a few days reduces this. Possibly a thimble would reduce splinters however this was not tested. The stings were not strong, more a slight annoyance.

Beating the fibres against a tree did not remove impurities as there was not enough pressure to remove remaining fragments of core, but possibly beating them with a wooden board would be more effective (scutching). Teasels were trialled as a method of cleaning impurities but were ineffective. They became tangled with the fibre and impurities but did not separate them. However, they were used to raise the
nap on woollen fabric in the medieval period (Wild 1988), known as ‘fulling’, which made the fabric warmer. Therefore, they could perhaps have been used after weaving to further process the textile.

3.7 Splicing

The loose fibres must then be turned into yarn. Yarn was created by holding fibres in the left hand and spinning them tightly anticlockwise with the right hand. Then the midpoint of the yarn is held, and the two ends are spun together clockwise tightly, which plies the yarn. However, this limits the length of the yarn to the length of the fibre bundle.

To extend the length of the yarn, splicing can add new fibres into the yarn. End to end splicing seemed to be less secure compared to continuous splicing due to the weak join points. The fibres are twisted anti-clockwise between fingers for a few centimetres, then more fibres are added, and the twisting continues (Cooke et al. 1991) (Figure 12a). This is repeated for the whole yarn. It is also necessary to wet the joining points with either water or saliva to create a ‘glue’ to hold the splices in (Leuzinger and Rast-Eicher 2011; Cooke et al. 1991). Then the yarn must be plied in the opposite direction, which begins automatically when the yarn is tightly spun.

This can all be done without gloves as the stings are only on the outer bark. It is essential to remember which direction the yarn is being twisted so it does not fall apart. It is also necessary to spin tightly. The twisting can be done in either direction, as long as the plying is the opposite direction.

There is no experimental research available for splicing on nettle textiles in the Bronze Age. The only experimental research available on splicing is either linked to Neolithic and Bronze Age flax (Leuzinger
and Rast-Eicher 2011) or to Egypt (Cooke et al. 1991). The Egyptian system is especially elaborate and requires multiple people as explored in the literature review, so this has not been attempted.

My yarn was usually around 4mm thick (Figure 12b). One piece was worn around my wrist all day and stayed secure. Whilst not soft, it was not unpleasant or itchy. Splicing can be done with green unprocessed fibres, which makes a strong but messy cordage which could be used for nets, clothing, attaching tools and hafts, bags and pendants (Hardy 2008).

### 3.8 Weaving

Weaving was carried out using the spliced yarn and a simple wooden hand loom purchased from a craft shop. Weaving consists of two sets of threads (warp and weft) which are interlaced to form cloth (Harris 1993). Warp weighted looms were used in the Bronze Age (Grömer 2013) but were not available for this study. Ideally an experimentally produced loom would have been used, but improvisation was necessary (Coles 1979:46).

A test piece was woven using different colours of embroidery thread (blue weft, light pink warp 1, dark pink warp 2) which helped to prevent confusion. A 5cm square was woven in 1 hour. It was easy to forget to tilt the heddle rod, and a comb was necessary to keep the weaving neat.

A narrow piece of nettle fabric was woven using Batch C thread. I predicted that I would not have enough thread, but there was sufficient thread likely due to its thickness (2mm). The warp threads broke several times under the tension and could not be twisted back together. Therefore, I tied them with a knot and tightened up the slack by wrapping the extra thread around a pin at the warp beam, as the tension was necessary to be able to weave (Harris 1993). Neither the warp nor the weft threads were
plied, however if the warp were plied that may have helped with thread strength. The weft did not need to be continuous, so shorter pieces of thread could be woven in, although Barber argues (1991:9) that a continuous weft is more effective as the weft turns from row to row it binds the edge (self-edge or selvedge) keeping finished work from slipping out of place.

The heddle rod was not effective at distinguishing between the warp threads, possibly due to incorrect tension or the thread thickness being too large (Figure 12c). Initially, I used the weaving shuttle but then began threading the weft by hand which seemed to result in a tighter weave. I used the plastic comb provided to keep the threads even and close, but a comb made from wood or other materials would have been equally effective.

A plain weave or tabby was created as it was the easiest and is the most common type found in the Bronze Age (Randsborg 2011) (Figure 12d). The weft passes under and over successive single warp threads (Wild 1988). Seemingly the loosely woven section was less soft than the tightly woven section, perhaps due to the thread count. Even with the tightly woven section, the fabric was not very soft especially by modern standards, however it may soften with washing and beating.
Figure 12: (a) process of splicing (b) spliced nettle thread (c) loom set up with nettle thread (d) woven nettle textile (Sawyer 2019)
3.9 Burning

The nettle fabric was cut into smaller squares of 1.5cm² using scissors and measured using a ruler (Figure 13). The samples were placed into crucibles: one without a lid (oxidizing), one with a lid (reducing) and one under ash (Figure 14). The ash was formed from hazel wood, sieved to 2mm, as it was available in the laboratory. Ash was placed in the crucible to a depth of 1cm, then the sample, then another 0.5cm of ash. These different conditions were chosen due to Boardman and Jones’ (1990) experiment on charring cereal components to investigate carbonisation and destruction. Destruction of buildings by fire often produces a wide range of charring conditions (Charles et al. 2015:12), so this has been reflected in the experiment. Reducing conditions should still have some air to mimic archaeological charring (Charles et al. 2015:7), so the lid was not airtight.

250 degrees celsius was chosen as an initial trial temperature to form appropriate parameters (Outram 2008) for future trials. The samples were placed into the furnace for 5 hours (Boardman and Jones 1990), checking the oxidising sample visually every 15 minutes to monitor carbonization.

At 250°C the samples blackened but did not disintegrate, so the experiment was repeated at 50°C intervals (300°C, 350°C, 400°C). The ash was reused for each temperature increase. The samples were allowed to cool to room temperature then held with tweezers when removed from the crucibles to prevent damage.

Carbonisation was recognised as a change in colour to black and destruction was recognised as pale grey ashes, based on criteria developed by Boardman and Jones (1990). Colour is not always a good test for recognising carbonisation, as there is variation between material (Charles et al. 2015:6) however it can be quickly and easily recorded unlike other methods.
3.10 Conclusion

Research methods employed include literature research and experimental archaeology simulations. Where possible, this study was underpinned by an experimental archaeology approach, following accepted guidelines where possible. However, this experiment was small scale and did use some modern tools, which may limit its significance.

Figure 13: 1.5cm² nettle textile samples (Sawyer 2019)
Figure 14: Charring experiment set up (Sawyer 2019)
4. Results

Results have been separated into the two experiments: general observations on the textile simulation and qualitative observations on the carbonisation simulation.

4.1 General observations on nettle textile simulation

The main observation from the nettle fabric simulation is that it is time consuming, taking over 50 hours to produce a 30cm by 5cm piece. It also required far more raw material than expected, double the initial estimates. Retting can be carried out in a variety of methods but is not essential for producing yarn. Once the nettles are cut and dried, they do not sting, so protection is only needed for harvesting and removing leaves. Plying is not necessary for the weft but is for the warp threads as they are under tension.

Table 2 shows how many working hours were involved in the production of the nettle textile samples in a ‘time trial’ (Peacock 2001:182). The final woven sample was made of Batch C fibres so took 51.25 hours in total. Cleaning the fibres was the most time consuming task, 41.75 hours in total.

Table 5: Total hours in nettle textile production simulation

<table>
<thead>
<tr>
<th></th>
<th>Batch A (dew retted, non skip)</th>
<th>Batch B (dew retted, skip)</th>
<th>Batch C (unretted)</th>
<th>Total time/hours</th>
</tr>
</thead>
<tbody>
<tr>
<td>Harvesting</td>
<td>2</td>
<td>3</td>
<td>-</td>
<td>5</td>
</tr>
<tr>
<td>Strip leaves</td>
<td>1.5</td>
<td>2</td>
<td>-</td>
<td>3.5</td>
</tr>
<tr>
<td>Retting</td>
<td>4</td>
<td>-</td>
<td>-</td>
<td>4</td>
</tr>
<tr>
<td>Extract fibre</td>
<td>4</td>
<td>4</td>
<td>12.25</td>
<td>20.25</td>
</tr>
<tr>
<td>---------------</td>
<td>---</td>
<td>---</td>
<td>-------</td>
<td>-------</td>
</tr>
<tr>
<td>Cleaning</td>
<td>8</td>
<td>8</td>
<td>25.75</td>
<td>41.75</td>
</tr>
<tr>
<td>Splicing</td>
<td>2</td>
<td>2</td>
<td>4.75</td>
<td>6.75</td>
</tr>
<tr>
<td>Weaving</td>
<td></td>
<td></td>
<td>3.5</td>
<td>3.5</td>
</tr>
<tr>
<td>Total time/hours</td>
<td>19.5</td>
<td>21.5</td>
<td>51.25</td>
<td>84.75</td>
</tr>
</tbody>
</table>

4.2 Carbonisation simulation experiment

The samples changed from pale green to dark brown to black to grey as the temperature and time increased, which indicates carbonisation to ash.

At 250°C, the oxidising sample went from pale green to dark brown within 15 minutes, and black by 1 hour 30 minutes. The weave remained intact, and the sample did not disintegrate apart from 1mm loose fibres by 5 hours. The reducing sample turned black, the weave remained intact and stable by 5 hours. The under-ash sample turned black, the weave remained intact, and it was softer than the others.

At 300°C, the oxidising sample went from pale green to dark brown within 15 minutes and black by 30 minutes. By 5 hours, the weave remained intact, and although it was a little shrunken and fragile, the sample did not fall apart. The reducing sample turned black, the weave remained intact, shedding 1mm fibres and staying stable. The under-ash sample completely disintegrated in the first trial, which was unexpected so was repeated to check if anomalous. In the second trial the sample turned white with black areas and the weave fell apart.
At 350°C, the oxidising sample went from pale green to black in 15 minutes and had a greyish tint by 3 hours 45 minutes, also shrinking in size. By 5 hours it was black with a greyish tint and shedding 1mm fibres, but the weave stayed intact. The reducing sample turned grey and had a warped shape, shedding 1mm fibres, although the weave remained intact. The under-ash sample turned pale grey and disintegrated when touched. The weave was visible but very fragile.

At 400°C, the oxidising sample went from pale green to grey/black within 15 minutes, changing to pale grey with black tips in 30 minutes, then completely pale grey by 4 hours. The weave was visible, but the sample was very fragile, falling apart when touched. The reducing sample turned pale grey, the weave was visible but fell apart when touched. The under-ash sample turned pale grey with black sections and completely disintegrated with only 5mm pieces of thread visible.

The samples preserved best in oxidising conditions, turning black but remaining stable until 400°C. In reducing conditions, the samples preserved at lower temperatures (250°C and 300°C) but turned ashy and disintegrated at higher temperatures. In under-ash conditions, the samples preserved very poorly from 300°C, turning pale grey and disintegrating.

4.3 Conclusion

All results have been included and will be interpreted in Chapter 5. This experiment was small scale and qualitative, so should be repeated if possible by another researcher.
Table 6: Textile samples after 5 hours of charring at various temperatures and conditions (Photos by Veitch 2019, no scale was provided, samples are 1.5cm²)

<table>
<thead>
<tr>
<th>Temperature /°C</th>
<th>Oxidising</th>
<th>Reducing</th>
<th>Under ash</th>
</tr>
</thead>
<tbody>
<tr>
<td>250</td>
<td>![Image]</td>
<td>![Image]</td>
<td>![Image]</td>
</tr>
</tbody>
</table>
5. Discussion

The results indicate that nettle textiles would have been time consuming to produce and preserve remarkably well under carbonising conditions. In addition, they preserve very poorly in reducing and under ash conditions which was unexpected.

5.1 Research Question 1: What is involved in the production of nettle textiles?

This study has shown that the production of nettle textiles is very time intensive and also required more raw materials than expected, which is common for textile investigations (Andersson Strand 2012:23). Therefore, nettle textiles produced would have been very valuable objects, as they represent a huge time investment. Because textiles are often neglected in archaeology, this means that more status is given to inorganic remains, whereas in reality organic objects were likely more important (Hurcombe 2008).

Nettle textiles are very time consuming to produce, perhaps even more than other fibres such as wool or flax, so it’s possible that Bronze Age people needed it for some special property, such as warmth. Ritual associations are possible given the ‘magical’ transformation from painful stings to soft fabric. Although the production of nettle textiles requires specific knowledge, it is not highly skilled and can easily be taught to beginners, as I was able to teach a friend within one hour. Therefore, multiple members of the community could be part of the activity, rather than a specialist. It’s possible that small hands would have an advantage in making fine thread in splicing, so this activity could have been for women and children.
Many processes were assumed to be essential (retting, spinning) based on 19th century textiles, whereas in reality prehistoric people were creating textiles in very different ways (Gleba and Harris 2018). This shows the importance of analysing all available evidence, including the surviving remains, rather than assuming that textiles have been the same throughout history.

5.2 Research Question 2: How do nettle textiles preserve in an experimental setting?

Remarkably the nettle samples preserved at much higher temperatures than expected, only turning to ash at 400°C oxidising. Therefore, their preservation in the archaeological record is not a carbonisation issue, but a mechanistic issue when they are in the soil, as surviving examples of nettle textiles are exceptionally rare. Perhaps this is due to moisture or pH damaging the textile after they are covered in soil.

In addition, the reducing and under ash conditions normally protect the material (Charles et al. 2015:12; Boardman and Jones 1990), so the fact that the samples were less well preserved under those conditions is unusual. Carbonisation occurs under complex conditions and preservation is variable (Boardman and Jones 1990) so these results should not be taken as proof (Coles 1979) but a guide for further investigation.

5.3 Research Question 3: Is it possible to identify nettle textiles in the archaeological record?

Seeds and pollen are the most commonly retrieved archaeological plant remains, and are often interpreted as nourishment, for instance linseeds, however they could easily have been used for fibre production (Andersson Strand et al. 2010:160; Willerding 1973:235). This could be applied to nettle
seeds or pollen, which are commonly found on archaeological sites (Walton 1989) and could have been used for textiles.

Nettles have a high concentration of phytoliths (Tsartsidou et al. 2007) which are unique as they contain calcium carbonate (Mulholland and Rapp 1992:2). Therefore, the presence of these phytoliths likely means that nettles were present and could hypothetically have been used for textiles. However, because nettles tend to grow near human settlements without encouragement, this inference should be viewed with caution.

As previously mentioned, Hurcombe’s (2010) investigations of silica on flint tools in the Late Mesolithic and Neolithic has helped to identify textile processing when no organic remains survive. These tools are very common in the British Neolithic and would have been used repeatedly, suggesting significant activity (Hurcombe 2010). Hurcombe’s (2010) method would only work on nettle stems, not flax, so the tool could be used to suggest nettle processing at sites.

Recent archaeological work on dental calculus has shown its potential as a reservoir of dietary and non-dietary debris, even finding wool and plant fibres (Radini 2016; Blatt et al. 2011). Given that splicing involves wetting each joining point, often with saliva, it seems possible that nettle fibres could be found in the calculus of those who made thread.

Generally cellulose fabrics are assumed to be made from flax, but recent research has shown that this is misleading, and that nettle textiles could be more common than anticipated (Barber 1993). Bergfjord and Holst’s (2010) method using polarised light microscopy to measure the fibrillar orientation of fibres and to detect the presence of calcium oxalate crystals is very promising and only requires a small
amount of material. Nettles can be identified using this method by their S fibrillar orientation and clustered crystals (Bergfjord and Holst 2010).

5.4 Research Question 4: What is the future for nettle textiles in archaeology and beyond?

This study has raised many avenues for future research including more splicing experiments as there was very little information to draw from, and the method used may not be correct. The cleaning method used may also be inappropriate for the Bronze Age, and future research should investigate fibres being scutched or beaten with a wooden board, as this could have been used in the Bronze Age. The fibres should also be woven using a warp weighted loom, as this is Bronze Age appropriate. In addition, nettle usage in basketry, netting and matting should be investigated. The fabric should also be processed further to improve its softness, perhaps using teasels.

Dental calculus from archaeological skeletons could also be analysed for nettle fibres and phytoliths, which would provide direct evidence for production of yarn. This would likely differ from ingestion of nettles as food, as only the leaves are eaten. The fabric should also be worn to see if it is warm, itchy, strong etc. Other properties should be investigated such as fire resistance, especially when blended with wool. In addition, more efficient methods of processing the stems to extract and clean the fibre should be investigated.

Nettle fibres could provide a renewable and sustainable alternative to cotton, given the enormous quantities of water and pesticides needed to grow the latter (Harwood and Edom 2012; Lepisto 2009; Preuss 2017). Cotton accounts for 20% of the world’s pesticides (Bennet 2004), whereas nettles grow easily without chemical intervention. In addition, nettles grow easily in Europe, allowing an alternative,
more local textile chain (Vogl and Hartl 2003: 119) with more control and accountability than a global one.

Pure nettle textiles are not available on the commercial market yet, however there are some mixed yarn examples such as a cotton and nettle backpack by Trakke (Farmer n.d.) inspired by the Swiss Army backpack in World War Two. Italian fashion house Corpe Nova created jeans with nettle yarn in 2004 (Bennett 2004) but appear to have dropped the project since. Camira Fabrics appear to be the only company producing nettle blended textiles on an industrial scale, for instance their Nettle Collection is blended with wool (Camira n.d. b.). Continuing limiting factors include a lack of suitable harvesting technology; large scale fibre processing or large-scale textile processing (Vogl and Hartl 2003:126).

An increasingly common commercial nettle fabric is ramie, which is produced from either *Boehmeria nivea* or *Boehmeria tenacissema*, which are stingless (Gordon Cook 1984:22). It contains more fibre than the common stinging nettle (Harwood and Edom 2012), making it more cost effective to produce commercially. The crop can also create work and income to many Nepalese people as it grows well in Nepal (Grady 2010).

Other possible uses for the crop include as an environmentally sound replacement for glass or carbon fibres in the automobile industry and as an asbestos replacement (Vetter et al. 1996; Vogl and Hartl 2003:126). In addition, nettles can reinforce polymers such as PLA (polylactic acid) instead of glass to reduce their environmental impact (Suryawan et al. 2017).
5.5 Limitations and recommendations

One of the limitations of the nettle textile simulation is that some modern materials were used such as: a plastic comb in weaving, plastic sheeting to transport the stems, butter knife to clean fibres and metal billhook to cut stems. In any future investigations, it is recommended that only materials available to the time period should be used (Coles 1979:46). As previously mentioned, this study was small scale and should be repeated with greater quantities of people to ascertain the teachability of various methods and repeatability.
6. Conclusion

Nettle textiles would have been time intensive to produce in the Bronze Age so would have been valuable objects. Their production was not skilled or specialised, so would likely have involved multiple members of the community rather than one specialist. They also required large quantities of raw stems, which would have been easily accessible from wild nettles. It’s possible that nettles were exploited in the Bronze Age for special qualities unknown to us.

The samples preserved remarkably well under oxidising conditions in a furnace to 350°C, so their rarity on archaeological sites could be due to other issues, such as moisture damage or soil pH. Unusually the samples preserved badly in reducing and under ash conditions which is atypical and should be investigated further.

Due to their poor preservation in the archaeological record, proxies could be used to identify nettle textiles such as dental calculus, phytoliths, seeds, pollen and silica on tools. In addition, surviving cellulose textiles that were thought to be flax should be reanalysed using Bergfjord and Holst’s (2010) method.

Finally, *Urtica dioica* could be used in the future as a more sustainable fibre, especially compared to cotton. However, commercial production is yet to be widespread due to issues in extracting fibres from the bark.
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